# TM 11-4040

WAR DEPARTMENT TECHNICAL MANUAL

# RADIO TRANSMITTERS BC-1149 and BC-1149-A (TARGET)

## REPAIR INSTRUCTIONS

*WAR DEPARTMENT · DECEMBER 1945*

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TM 11–4040, Radio Transmitters BC–1149 and BC–1149–A (Target), Repair Instructions, is published for the information and guidance of all concerned.

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*Chief of Staff*

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Refer to FM 21–6 for explanation of distribution formula.

# CONTENTS

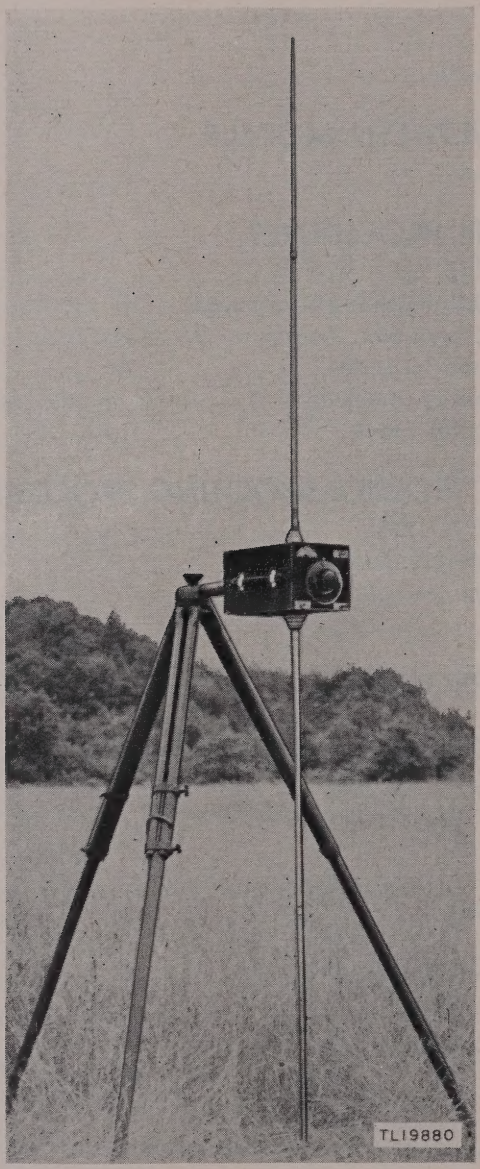



*Figure 1. Radio Transmitter BC–1149–(*) (Target), in operation.*

# SECTION I

# DESCRIPTION OF RADIO TRANSMITTER BC–1149–(*) (TARGET)†

## 1. Use of Equipment

*a.* Radio Transmitter BC–1149–(*) (Target) is used specifically as a target at predetermined positions about the directional antenna of direction-finding equipments such as Radio Set SCR–502 in order to calibrate and check the functioning of these equipments. Figure 1 shows the transmitter set up for operation. It is used in conjunction with a mounting support, a tripod, and two antenna rods.

*b.* Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this manual. Thus Radio Transmitter BC–1149–(*) (Target) represents Radio Transmitters BC–1149 and BC–1149–A, which are treated together in this manual.

†See TM 11–243 for installation, operation, and other maintenance data on this equipment.

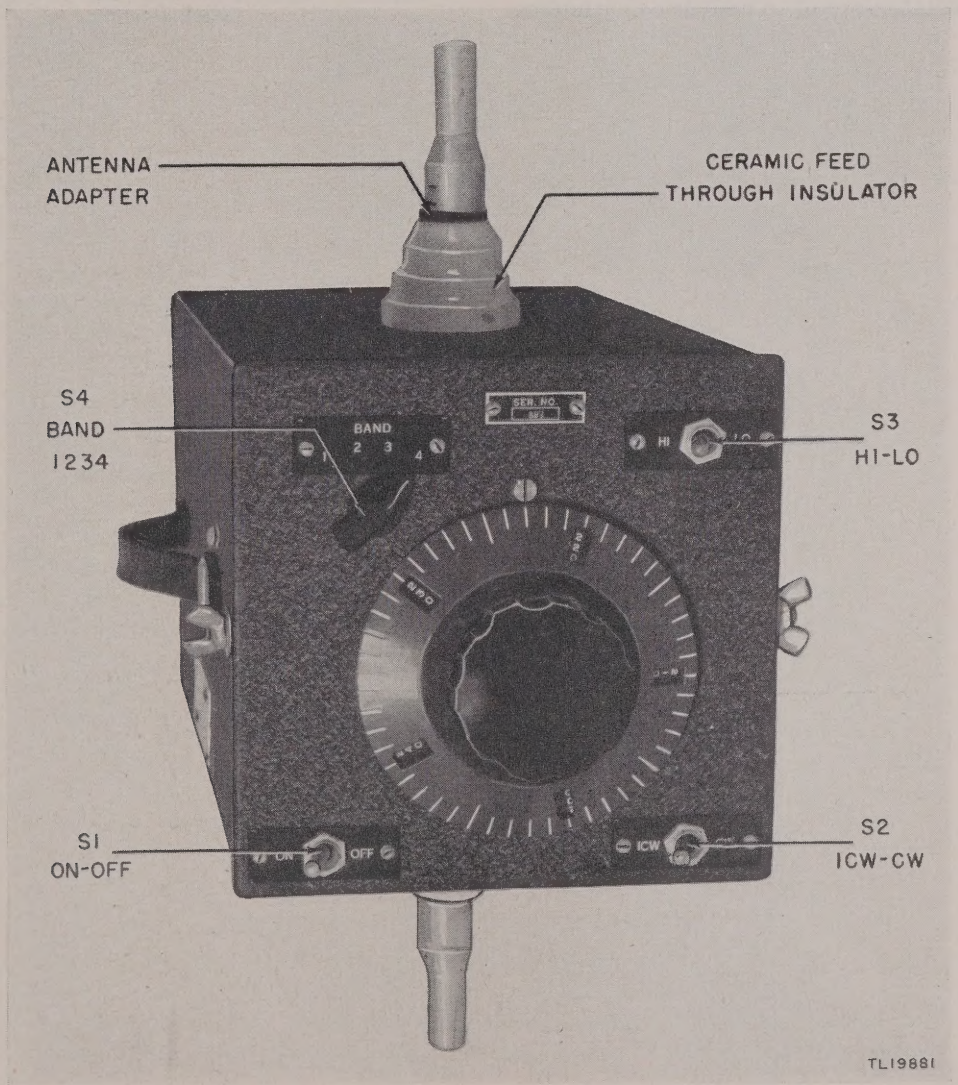



*Figure 2. Radio Transmitter BC–1149–(*) (Target) front view.*

## 2. Characteristics

Radio Transmitter BC–1149–(*) (Target) is a set capable of delivering a modulated or unmodulated low-power signal, as required. The transmitter covers a frequency range from 1.5 to 32 megacycles (mc) in four bands as follows:

| *Band* | *Nominal range (mc)* | *Band* | *Nominal range (mc)* |
|---|---|---|---|
| 1 | 1.5 to 3.0 | 3 | 7.0 to 15.0 |
| 2 | 3.0 to 7.0 | 4 | 15.0 to 32.0 |

## 3. Over-all System Function

Radio Transmitter BC–1149–(*) (Target) is a two-tube, battery-operated set. (See fig. 2.) A loktal type JAN–3B7/1291 (VT–182) 1.4 volt twin-triode tube, V1, is used in a conventional push-pull oscillator circuit to deliver a continuous-wave (c-w) target signal. A minature type JAN–1R5 (VT–171) 1.4 volt pentagrid tube, V2, is used as a self-excited resistance-capacitance audio interrupter to cut off the oscillator intermittently, in order to produce an i-c-w signal.

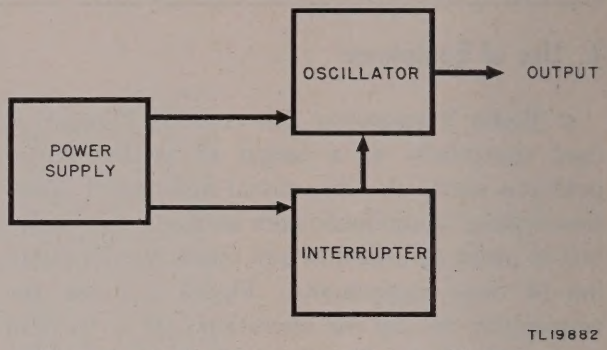



*Figure 3. Radio Transmitter BC–1149–(*) (Target), block diagram.*

# SECTION II

# DIFFERENCES BETWEEN MODELS

## 4. Functional Difference

There are two models of Radio Transmitter BC–1149–(*) (Target), Radio Transmitters BC–1149 and BC–1149–A. These models are identical electrically and mechanically, but BC–1149–A is used with Radio Set SCR–291–A (direction finding) and BC–1149 is used with Radio Set SCR–502 (direction finding).

# SECTION III

# INITIAL REPAIR PROCEDURES

*Note.* Before making any repairs or adjustments, all authorized Modification Work Orders should be applied. See FM 21–6 for list of applicable MWO's.

## 5. General

Maintenance personnel should follow the procedure outlined in this manual when repairing and overhauling Radio Transmitter BC–1149–(*) (Target). The repair information in this and the following sections is presented in the order in which the repairman should actually perform the various operations on the equipment in the repair shop. This procedure permits repair of the equipment in the shortest time possible, resulting in performance comparable to that of new equipment.

## 6. Special Tools, Test, and Cleaning Equipment

Below are listed the special tools, test, and cleaning equipment required to repair and overhaul this equipment.

*a.* TOOLS. The following tools are required:

| Item | Description |
|---|---|
| Screw drivers | ⅛-inch and ¼-inch, with insulated handle. |
| Pliers | Long-nose; cutting. |
| Soldering iron | |
| Mallet | Padded. |
| Dental mirror | Nonmagnifying. |

*b.* TEST EQUIPMENT. The following test equipment is required:

| Item | Description |
|---|---|
| Flashlight | Pen type. |
| Tube tester | Dynamic type. |
| Test set | Weston No. 772 or equivalent. |
| Vacuum-tube voltmeter | RCA No. 165 voltohmyst or equivalent. |
| Radio receiver | Approved model of BC–1147–( ) or equivalent. |

*c.* CLEANING EQUIPMENT. The following cleaning equipment is required:

| Item | Description |
|---|---|
| Sandpaper | Grade No. 0000. |
| Cloth | Lintless, 6 inches by 6 inches. |
| Brushes | Assorted sizes from ¼ inch to 1 inch. |
| Pipe cleaners | Tobacco Smoker's. |
| Solvent, dry-cleaning | |
| Blower | Compressed air. |

## 7. Removal of Chassis From Box

Unscrew the two antenna adapters and the wing nuts on each side of the front panel. Grasp the front panel by the edges and carefully pull the chassis out of the box.

## 8. Removal of Tubes and Batteries

Unscrew the battery nuts and remove the battery leads from the terminals. Loosen the battery-clamp screws, and remove the batteries. Now remove the tube shield, remove tube V2 from its socket, and the loktal tube V1 from its socket.

***Caution:*** Be extremely careful not to bend the prongs or break the envelopes of the tubes while removing them.

## 9. Inspecting and Cleaning of Chassis

Thorough cleaning of the chassis is necessary to insure best performance and to prevent corrosion, rust, and dirt from damaging parts or causing arc-over or low-resistance leakage between high-voltage points and ground. Check for cleanliness, inside and outside. Observe conditions of the finish and plating. Both paint and plating should be free of corrosion, blisters, flaking, bare or worn spots, or deep scratches. Inspect gasket for looseness, tears, or loss of elasticity. Check

switches S1, S2, and S4 for smooth operation. Switches should snap firmly into position, and there should be no appreciable backlash or slipping of the dial. Hardware, such as bolts, nuts, screws, clips, and sockets, should be tight. Check for broken solder joints, loose connections, frayed or

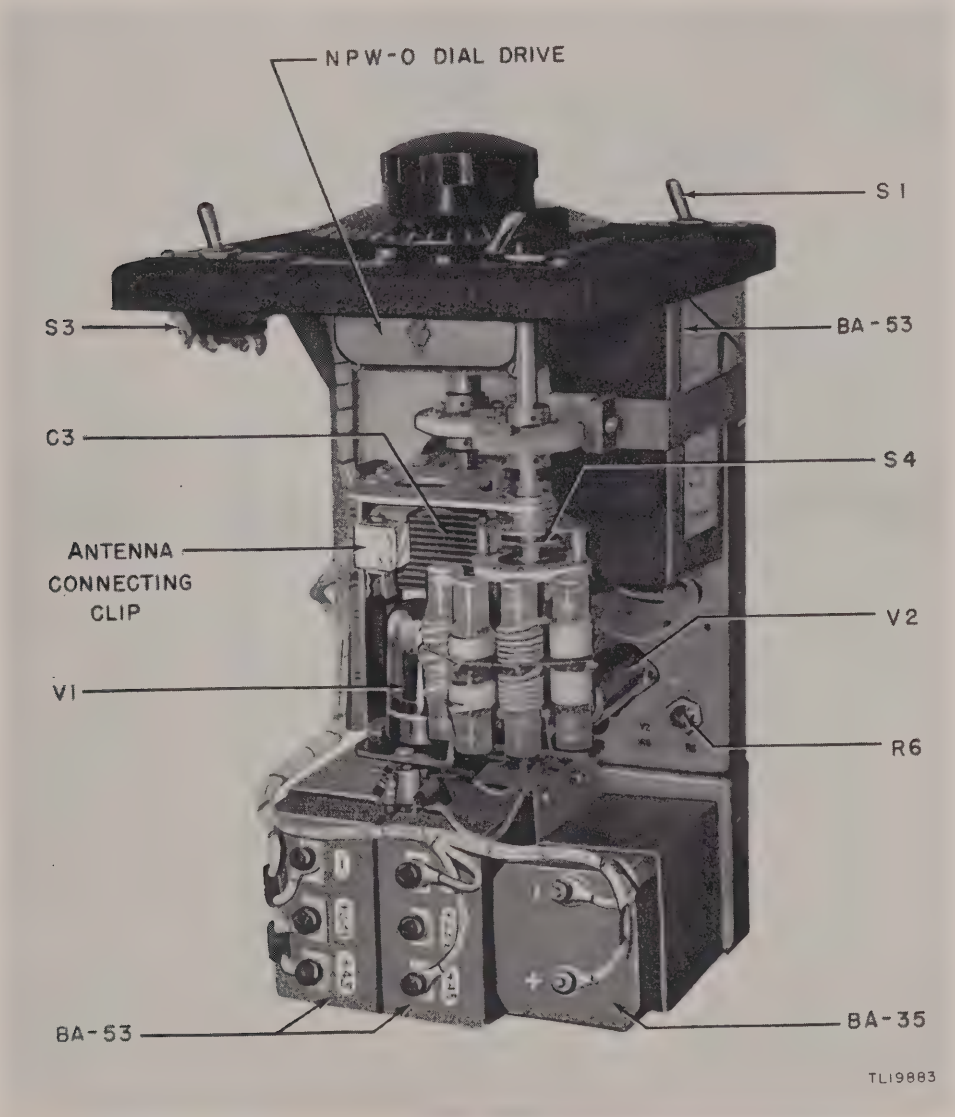



*Figure 4. Radio Transmitter BC–1149–(*) (Target), top view of chassis.*

burned insulation, and burned or charred resistors and coils. Make a careful inspection of tube sockets for broken contacts; inspect the band switches for loose or bent contacts or broken insulation. Replace badly corroded and damaged unit parts. Remove loose dust and dirt with a brush or blower. Remove dirt or grease which adheres to the chassis or parts, with a brush or cloth dampened with dry-cleaning solvent (SD). Clean band switches with a small brush or pipe cleaner dampened with dry-cleaning solvent (SD). Clean turning capacitor plates with a tobacco smoker's pipe cleaner dampened with dry-cleaning solvent (SD). Slight corrosion should be removed with dry-cleaning solvent (SD). If this method does not succeed, use sandpaper No. 0000 on contacts or other delicate parts, and No. 00 or No. 000 on the chassis or other sturdy parts. Tighten all loose hardware.

## 10. Cleaning and Testing of Tubes

Replace badly corroded or damaged tubes. Remove slight corrosion with a brush or cloth dampened with dry-cleaning solvent (SD) or No. 0000 sandpaper, being very careful not to bend the tube prongs. If necessary, retin the prongs. Insert tubes one at a time in proper socket in dynamic type tube tester. Test for short circuits, emission, transconductance, and power output. If readings are below standard, or if readings fluctuate when tube is tapped, replace tube.

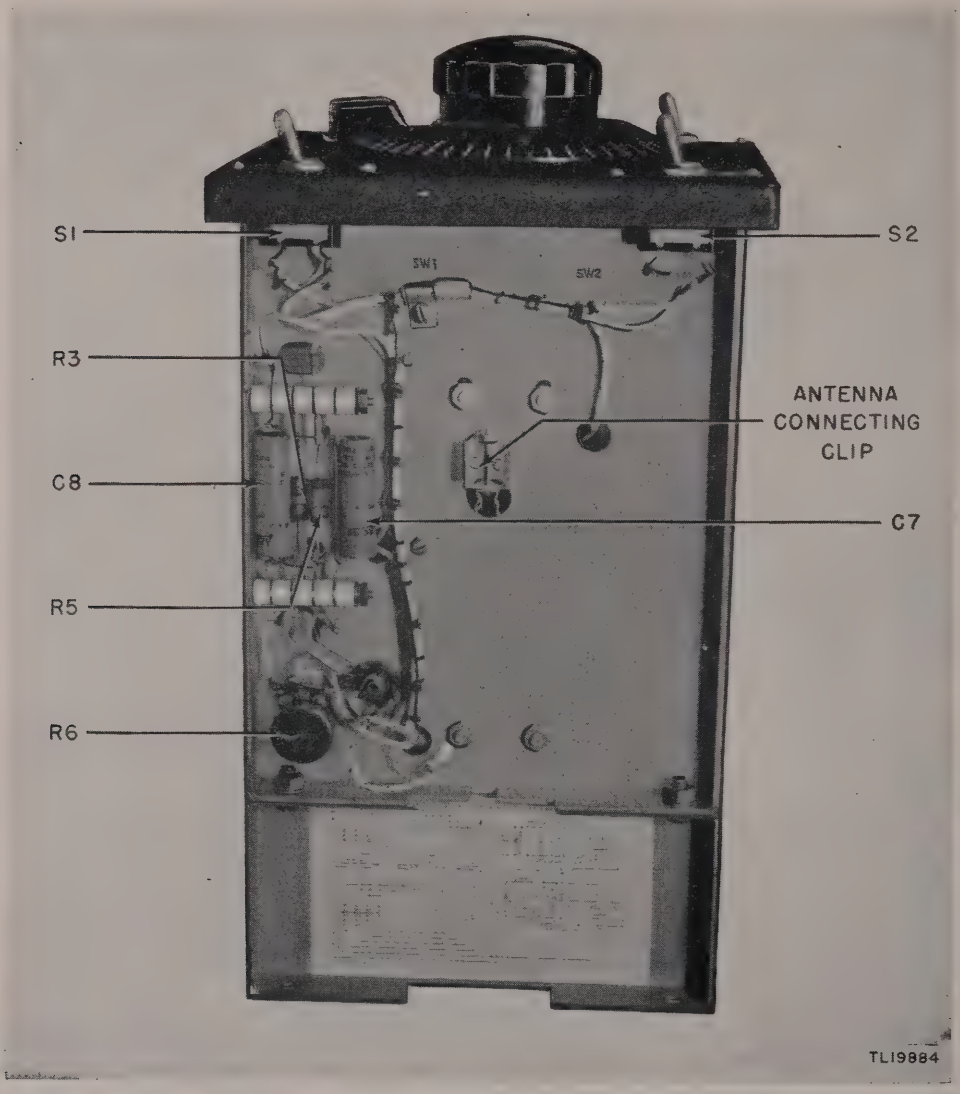



*Figure 5. Radio Transmitter BC–1149–(*) (Target), bottom view of chassis.*

# SECTION IV

# PRELIMINARY TROUBLE-SHOOTING PROCEDURES

## 11. General

This section covers the simple general tests which should be made prior to the detailed testing. These tests will yield valuable information on the condition of the unit parts of the equipment.

## 12. Input Resistance Measurements

With tubes and batteries removed, place switch S1 in ON position and switch S2 in ICW position. Place one lead of the vacuum-tube voltmeter (VTVM) on lower center terminal of switch S3 and the other lead on chassis (ground). The VTVM should indicate open circuit on the 100-megohm scale in both HI and LO positions of switch S3.

## 13. Input Voltage Measurements

Test the cutput voltages of Batteries BA–35 and BA–53 when the transmitter is operating. Use a high-resistance voltmeter in making these tests. Replace the batteries if the voltage reading obtained is less than the specified end-voltage-under-load value. The end voltage for Battery BA–35 is 1.45 volts; for Battery BA–53, 42 volts.

## 14. Operating Test

Install tubes. Install one Battery BA–35 and three Batteries BA–53 as shown in figure 4. Make sure the expiration date on the batteries has not been reached. Turn switch S3 to HI position, switch S2 to ICW position, and switch S1 to ON position. Check operation of the set on each of the four frequency bands by watching, smelling, and listening for any abnormalities of operation. For example, tubes may fail to light, or odors of melting wax or burning insulation due to overheating of unit parts or short circuits may be present. Also observe operation of the transmitter when switch S3 is on LO.

*Note.* Some smoking may occur due to fungiproofing varnish.

# SECTION V
# ALIGNMENT PROCEDURE

Not applicable

# SECTION VI
# DETAILED TROUBLE-SHOOTING PROCEDURES

## 15. General

The purpose of this section is to provide the procedure for localizing trouble to one particular stage and, finally, to the defective unit part. This procedure is indicated in step-by-step form in paragraphs 16 through 20. Procedure is also given for moistureproofing, fungiproofing, and refinishing the equipment.

## 16. Tube Tests

Because the tubes have been used since they were last tested, they should be tested now in accordance with paragraph 10. This is desirable in order to avoid the possibility that the tubes may have become defective in use. Then, in order to make absolutely certain that the tubes are not defective, they may be installed in place of like tubes in other equipment which uses these tubes in a similar capacity. If the operation of the equipment is adversely affected, the tubes are defective.

## 17. Voltage Analysis

*a.* General. Make voltage readings from tube socket pins to chassis with a vacuum-tube voltmeter under the conditions listed in the following paragraphs. Variations of more than 10 percent from the readings shown in figure 6 generally indicate a defective circuit.

*b.* Test Conditions. (1) Tuning dial at 1.6 mc.
(2) ICW-CW switch on ICW.
(3) HI-LO switch on HI.
(4) ON-OFF switch at ON.

*Note.* Figure 6 shows voltages with fresh batteries. Actual readings will depend on condition of batteries.

## 18. Resistance Analysis

*a.* General. Normal resistance readings at the tube socket pins are shown below. These readings are to be made with a VTVM when the tubes are removed. If variations of more than 10 percent are noted, make a complete point-to-point circuit check of the associated circuits in accordance with applicable schematic diagram.

*b.* Test Conditions. (1) ON-OFF switch OFF.
(2) ICW-CW switch on ICW.
(3) HI-LO switch on LO.
(4) Tubes in sockets.

***Caution:*** Disconnect batteries.

TUBE SOCKET RESISTANCES

| From tube or receptacle | Pin No. | To | Conditions | Resistance (ohms) |
|---|---|---|---|---|
| V1 | 1 | Chassis | All bands | 0. |
| | 2 | Pin 7 of V1 | | 0 (approx.). |
| | 3 | Chassis | | 40,000 ohms. |
| | 4 | Chassis | | 0. |
| | 5 | No connection | | |
| | 6 | Chassis | | 40,000 ohms. |
| | 7 | Pin 2 of V1 | All bands | 0 (approx.). |
| | 8 | Chassis | | 0. |
| V2 | 1 | Chassis | | 0. |
| | 2 | Pin 3 of V2 | | 75,000 ohms. |
| | 3 | No connection | | |
| | 4 | Chassis | | 0. |
| | 5 | Chassis | | 0. |
| | 6 | Chassis | | 75,000 ohms (approx.). |
| | 7 | Chassis | | 0. |

## 19. Point-to-point Check

*a.* General. Upon location of trouble in a particular stage, point-to-point measurements should be made in order to locate the defective unit parts. These measurements are made with the VTVM. Replace defective unit parts when found. See paragraphs 28 and 29 for the d-c resistance values of resistors.

*b.* Test Conditions. Remove batteries and turn power switch (S1) ON.

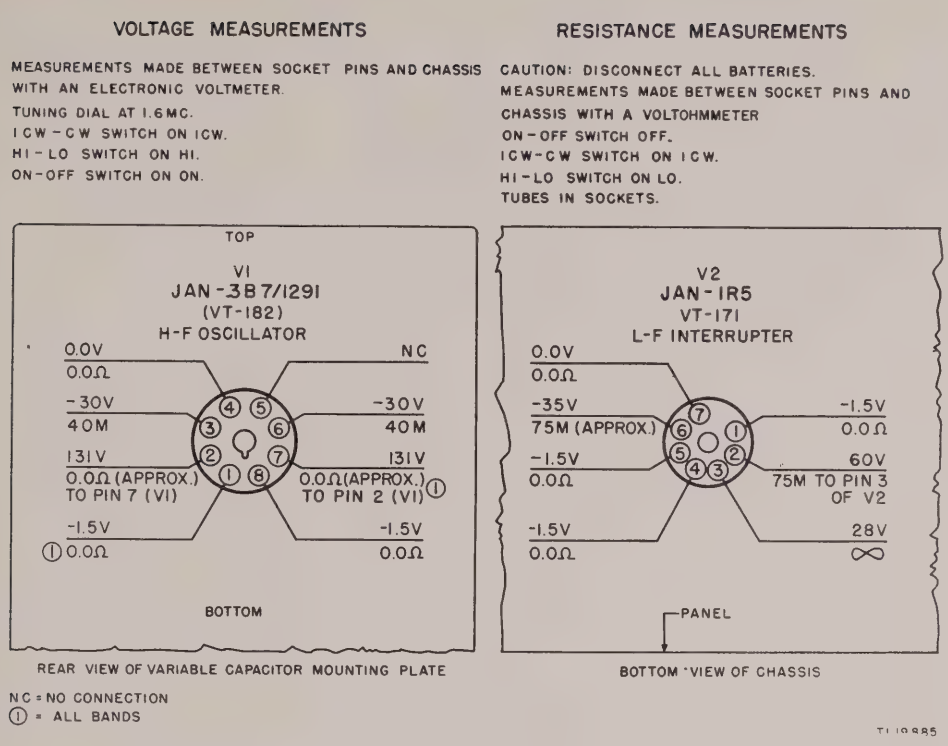



*Figure 6. Radio Transmitter BC–1149–(*) (Target), voltage analysis.*

*c.* Oscillator Stage. Check capacitors C1, C3, C4, C5, and C6 for short circuits. Check coils L1, L2, L3, and L4 for continuity, and resistors R1 and R2 for d-c resistance value.

*d.* Interrupter Stage. Check capacitors C7 and C8 for short circuits. Check resistors R3, R4, R5, and R6 for d-c resistance value.

## 20. Battery Test

Because the test made on the batteries in paragraph 13 could not be conclusive since defective unit parts had not yet been replaced, the batteries should now be tested again in accordance with paragraph 13.

## 21. Moistureproofing and Fungiproofing

*a.* When repairing equipment which has been treated with moistureproofing and fungiproofing varnish, it is necessary to clean the varnish from all connections which are to be soldered. After completing the repairs, apply the moistureproofing and fungiproofing varnish with a brush to the repaired connections and to all other parts from which the coating was removed.

*b.* Avoid applying the varnish to any points where electrical contacts must be made and broken, such as switches, jacks, binding posts, tube caps, and socket connections by masking these points. If the date of moistureproofing and fungiproofing marked on the equipment shows that it has been more than 6 months since the treatment was applied, it will be necessary to repeat the entire moistureproofing and fungiproofing process. Instructions for this process are contained in TB SIG 13.

## 22. Refinishing and Painting

If case is badly scarred or damaged, refinish it to prevent corrosion. Remove all rough spots using No. 00 and No. 000 sandpaper. Clean surface down to the bare metal, obtaining a bright smooth surface. Rust may be removed from the case or chassis by cleaning with dry-cleaning solvent (SD). In severe cases, it may be necessary to use both dry-cleaning solvent (SD) and sandpaper, alternating until every speck of rust has been removed. Small spots may be touched up with a small brush, but spray paint entire case if area of damage is extensive.

***Caution:*** The use of steel wool is not permitted While it makes possible quick removal of rust, it permits small particles of metal to enter the case with consequent damage to the equipment due to shorting or grounding of circuits.

# SECTION VII
# FINAL TESTING

## 23. General

After repairs have been completed on the equipment and it has been moistureproofed and fungiproofed, a final test must be made to make certain that the equipment is in proper condition for tactical use. The purpose of this section is to provide the procedure for making this final test. This procedure is indicated in step-by-step form in paragraphs 24 through 26.

## 24. Output Test

*a.* Test Conditions. (1) S2 on CW.
(2) S3 on HI.
(3) S1 on ON.

*b.* Requirements. The average of the outputs of the two dipole sockets to ground, without the antennas in place, will be not less than the values indicated below, as measured with two identical r-f vacuum-tube voltmeters, one on each dipole socket, in order to keep the output balanced.

OUTPUT REQUIREMENTS

| Band | Frequency (mc) | Minimum output (volts) |
|---|---|---|
| 1 | 1. 5 | 9. 0 |
| 1 | 2. 0 | 9. 5 |
| 1 | 3. 0 | 10. 0 |
| 2 | 3. 5 | 7. 0 |
| 2 | 5. 0 | 8. 0 |
| 2 | 6. 5 | 5. 0 |
| 3 | 7. 0 | 9. 0 |
| 3 | 10. 0 | 11. 0 |
| 3 | 15. 5 | 12. 0 |
| 4 | 16. 0 | 3. 5 |
| 4 | 22. 0 | 5. 5 |
| 4 | 32. 0 | 5. 5 |

## 25. Dial Calibration Test

On the side of the box of Radio Transmitter BC–1149–(*) (Target) is a frequency chart. This chart indicates the calibration of the dial. Place Radio Receiver BC–1147–(*), which is in satisfactory working order, or any other comparable c-w receiver with the same frequency coverage (1.5 to 32.0 mc), next to the transmitter, and set the receiver on the first frequency indicated on the transmitter frequency chart (1.5 mc). Turn the receiver and the transmitter on, put receiver BFO on, and turn the transmitter dial until the signal is loudest. Check the dial reading at the point against the dial setting indicated on the transmitter frequency chart. The difference between the two should be no more than 3 percent. Repeat this procedure for all the other frequencies on the transmitter frequency chart. In all cases where the tested dial reading is different from the dial setting indicated on the transmitter frequency chart, corrections should be made on the chart.

*Note.* The operational test described in paragraph 26 may be performed simultaneously with the dial calibration test.

## 26. Operational Test

During the performance of the dial calibration test (par. 25), switch the transmitter from HI to LO, and back and forth from CW to ICW a few times on each band. Also tap it gently with a padded mallet a few times on each band. The operation of the equipment should be satisfactory under all conditions, and should not be affected by the tapping.

# SECTION VIII
# INDIVIDUAL STAGE AND CIRCUIT REPAIR DATA

## 27. Power Supply Stage (fig. 7)

*a.* Special Circuit Features. Three standard Signal Corps 45-volt Batteries BA–53 are used to provide 67 or 135 volts for the plate circuits of the oscillator and interrupter. One standard Signal Corps 1.5-volt Battery BA–35 is used for filament power. Switch S1 connects cathode (pin No. 1) of the oscillator VI to the negative side of Battery BA–35 when it is in the ON position. Switch S2 connects cathode (pin No. 1) of the interrupter V2 to the negative side of Battery BA–35 when it is in the ICW position. Switch S3 provides 67 volts to the plate circuits when it is in the LO position and 135 volts when it is in the HI position. (See fig. 7.)

*b.* Parts Data For Power Supply Stage.

| Ref. symbol | Signal Corps stock No. | Name of part and description | Function |
|---|---|---|---|
| S1 | 3Z9849.39 | SWITCH: SPST | ON-OFF. |
| S2 | 3Z9849.39 | SWITCH: same as S1 | ICW-CW. |
| S3 | 3Z9849.22 | SWITCH: DPDT | HI LO. |

## 28. Oscillator Stage (fig. 8)

*a.* Special Circuit Features. The frequency of the push-pull oscillator VI is controlled on each band by the tank circuit consisting of the corresponding coil (LI for band 1, etc.) and the variable split-stator capacitor C3. The output of the oscillator for each frequency is coupled to the dipole antenna by an aperiodic coupling coil wound over the corresponding plate winding. Band switch S4 shorts the tank coil of band 2 when on band 4; the switch shorts the tank coil of band 1 when on band 3, to reduce absorption. Feedback voltage is obtained by cross-connecting the plate of each triode section to the grid of the other section through the respective coupling capacitors C4 and C5. Bias voltage is developed across the grid-leak resistors R1 and R2. The filament circuit is bypassed by capacitor C6. (See fig. 8.)

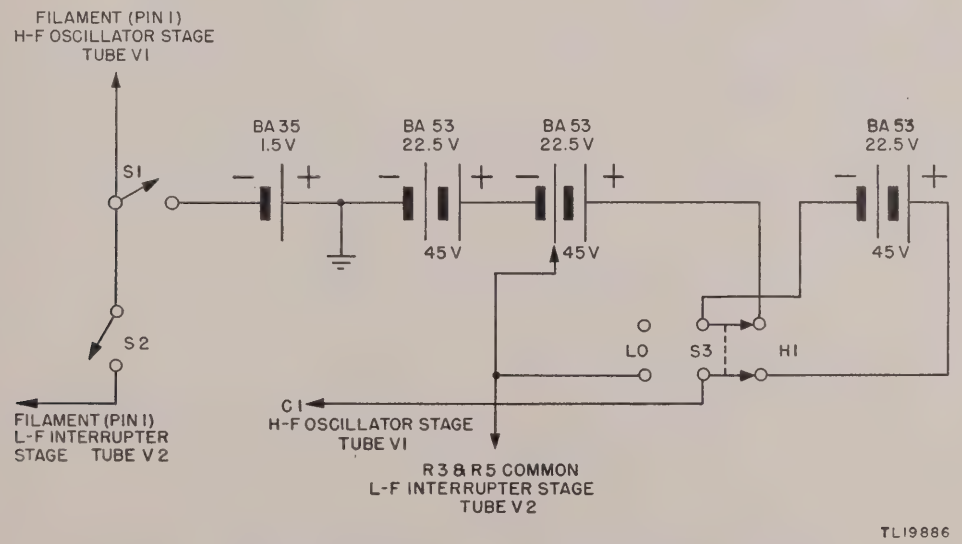
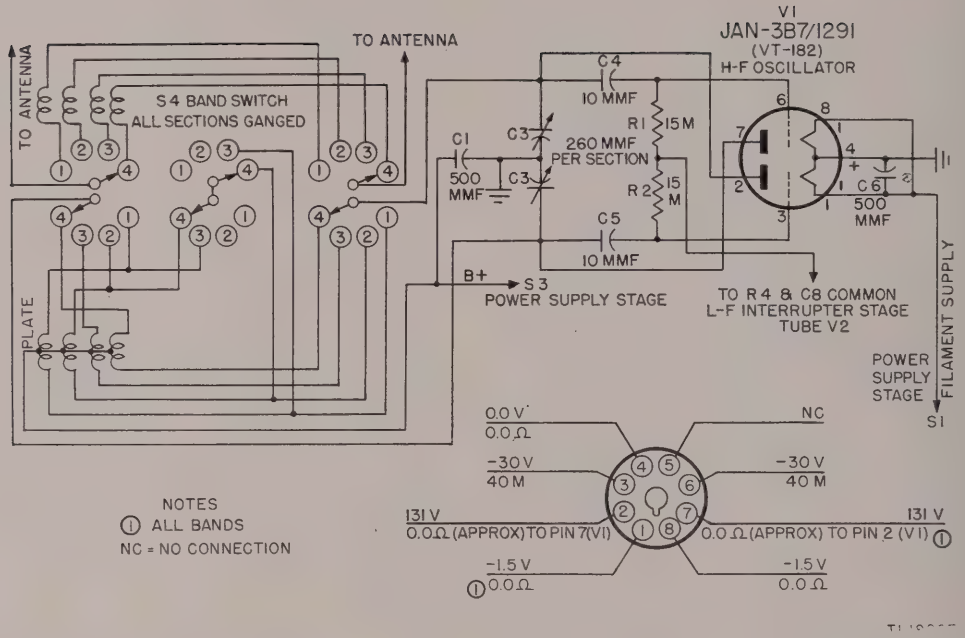



*Figure 7. Radio Transmitter BC–1149–(*) (Target), power supply stage.*




### VOLTAGE MEASUREMENTS

1. Measurements made between socket pins and chassis with an electronic voltmeter.
2. Tuning Dial at 1.6 MC.
3. ICW-CW switch on ICW.
4. HI-LO switch on HI.
5. ON-OFF switch on ON.

### RESISTANCE MEASUREMENTS

1. Disconnect all batteries.
2. Measurements made between socket pins and chassis with a volt-ohmmeter ON-OFF switch OFF.
3. ICW-CW switch on ICW.
4. HI-LO switch on LO.
5. Tubes in sockets.

*Figure 8. Radio Transmitter BC–1149–(*) (Target), oscillator stage.*

*b.* Parts Data for Oscillator Stage.

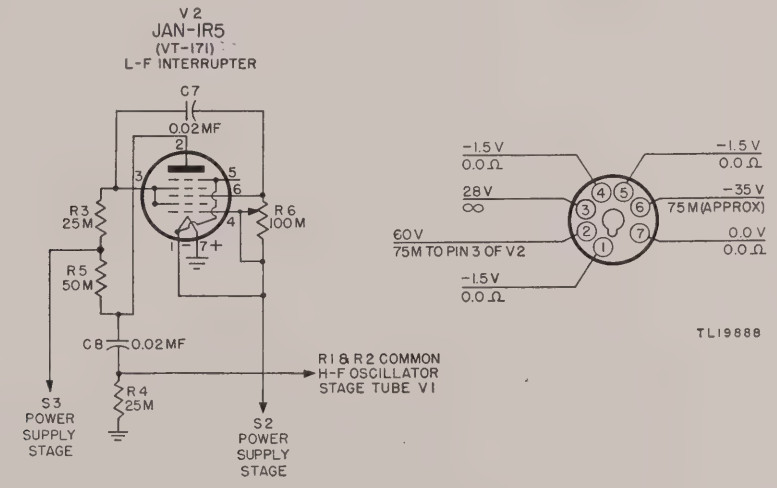
| Ref symbol | Signal Corps stock No. | Name of part and description | Function |
|---|---|---|---|
| C1 | 3K2051112 | CAPACITOR: 500-mmf, ±20%; 500 vdcw; mica. | Plate tank and heater bypass. |
| C3 | 3D9260V-6 | CAPACITOR: 2-section; 260 mmf per section; variable. | Tank circuit. |
| C4 | 3K2010011 | CAPACITOR: 10-mmf, ±10%; 500 vdcw; mica. | Grid coupling. |
| C5 | 3K2010011 | CAPACITOR: same as C4 | Grid coupling. |
| C6 | 3K2051112 | CAPACITOR: same as C1 | Plate tank and heater bypass. |
| L1 | 3C1084K-4 | COIL: band 1 | Tank circuit. |
| L2 | 3C1084K-5 | COIL: band 2 | Tank circuit. |
| L3 | 3C1084K-6 | COIL: band 3 | Tank circuit. |
| L4 | 3C1084K-7 | COIL: band 4 | Tank circuit. |
| R1 | 3Z6615-26 | RESISTOR: 15,000-ohm, ±10%; ½-watt; insulated. | Grid leak. |
| R2 | 3Z6615-26 | RESISTOR: same as R1 | Grid leak. |
| S4 | 3Z9550.5 | SWITCH: rotary; band | Band switch. |
| V1 | 2T182 | TUBE: JAN-3B7/1291 (VT-182); twin triode loktal base. | H-f oscillator. |

## 29. Interrupter Stage (fig. 9)

*a.* Special Circuit Features. The interrupter circuit consists of a resistance-capacitance oscillator based on the negative transconductance characteristics of the interrupter tube V2. The output of the interrupter is coupled to the grids of the r-f oscillator tube V1 through resistors R1 and R2. A pulsating bias voltage, which intermittently interrupts the operation of the r-f oscillator circuit is developed across resistor R4. The interrupter frequency is controlled by variable resistor R6. The interrupter circuit is turned on or off by switching the ICW-CW switch to ICW or CW, respectively. (See fig. 9.)

*b.* Parts Data for Interrupter Stage.

| Ref. symbol | Signal Corps stock No. | Name of part and description | Function |
|---|---|---|---|
| C7 | 3DA20-50.1 | CAPACITOR: 0.02-mf, ±20%; 400 vdcw; paper, oil-impregnated; hermetically sealed. | Modulator feedback. |
| C8 | 3DA20-50.1 | CAPACITOR: same as C7 | Plate coupling. |
| R3 | 3Z6625-37 | RESISTOR: 25,000-ohm, ±10%; ½-watt; insulated. | Screen grid dropping. |
| R4 | 3Z6625-37 | RESISTOR: same as R3 | Screen grid dropping. |
| R5 | 3Z6650-52 | RESISTOR: 50,000-ohm, ±10%; ½-watt; insulated. | Modulator plate dropping. |
| R6 | 2Z7271-16 | POTENTIOMETER: 100,000-ohm, ±20%; Type LM. | Modulator frequency control. |
| V2 | 2T171 | TUBE: JAN-1R5 (VT-171); midget; pentode. | L-f oscillator. |




VOLTAGE MEASUREMENTS

1. Measurements made between socked pins and chassis with an electronic voltmeter.
2. Tuning Dial at 1.6MC.
3. ICW-CW switch on ICW.
4. HI-LO switch on HI.
5. ON-OFF switch on ON.

RESISTANCE MEASUREMENTS

1. Disconnect all batteries.
2. Measurements made between socket pins and chassis with a volt-ohmmeter ON-OFF switch OFF.
3. ICW-CW switch on ICW.
4. HI-LO switch on LO.
5. Tubes in sockets.

*Figure 9. Radio Transmitter BC-1149-(*) (Target), interrupter stage.*

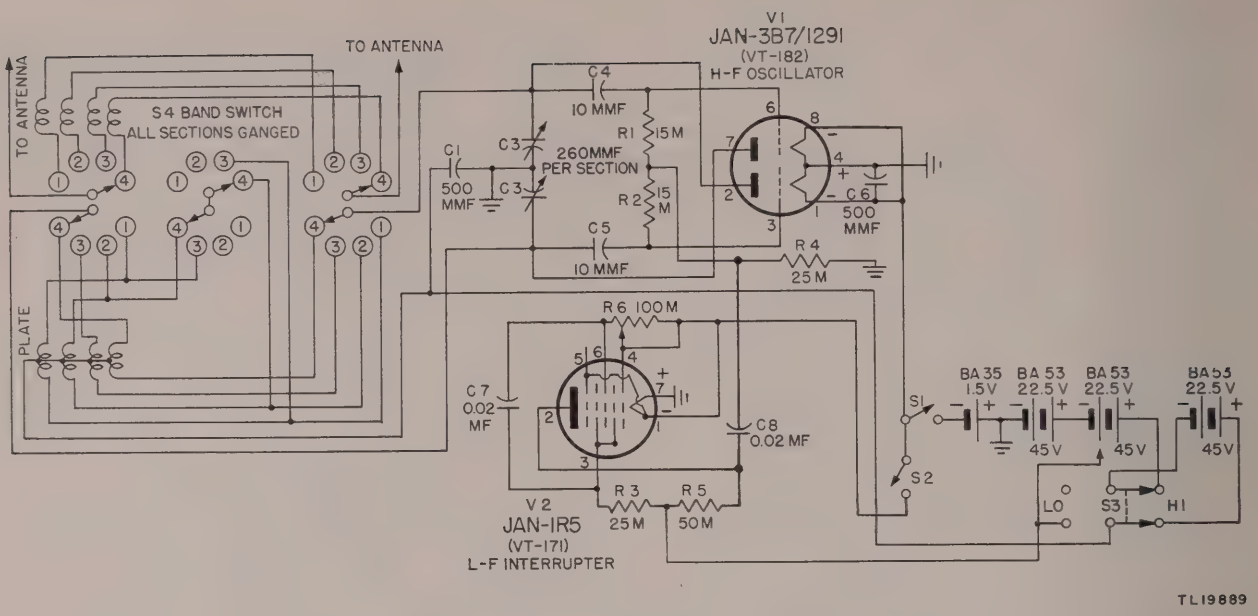



*Figure 10. Radio Transmitter BC–1149–(*) (Target), circuit diagram.*

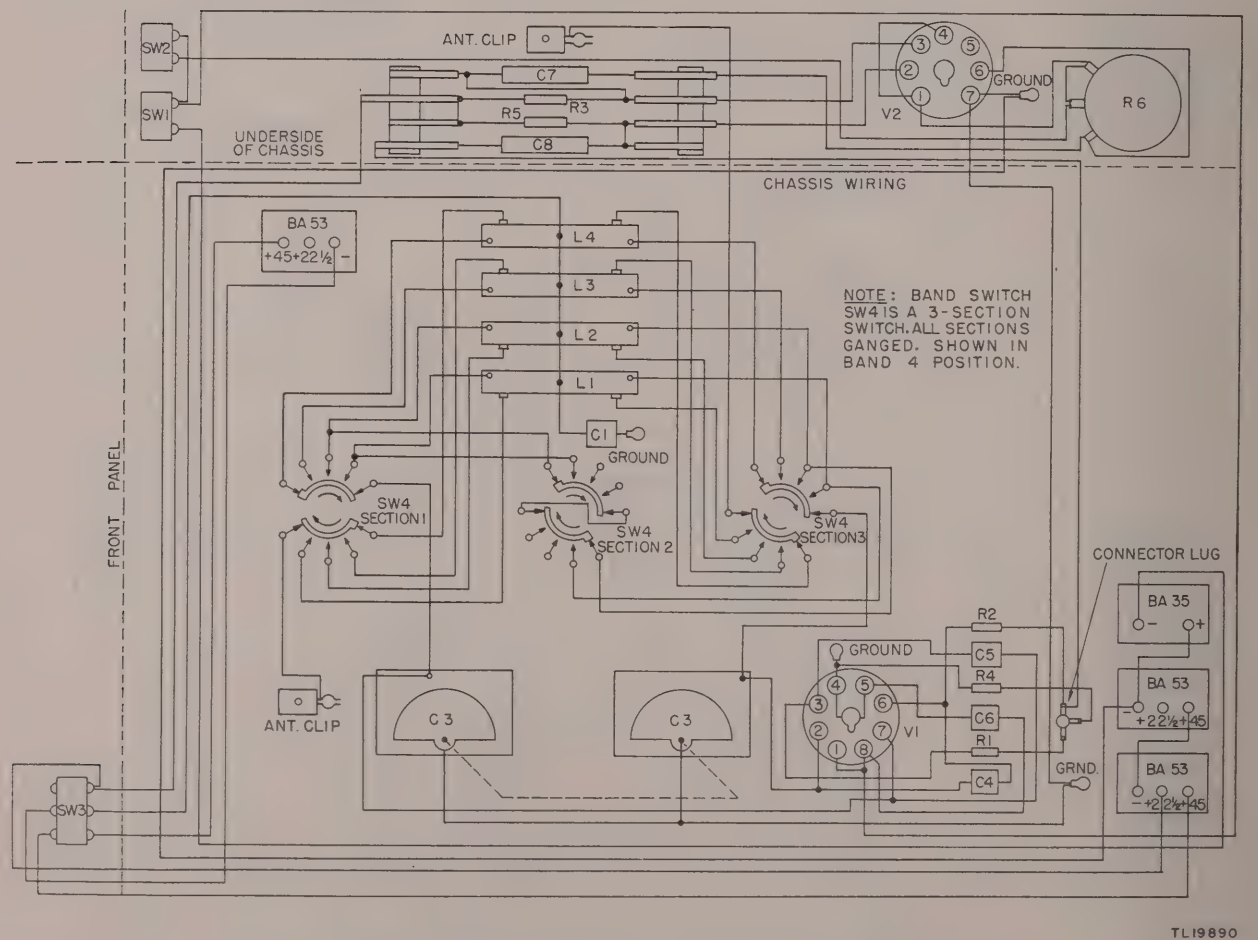



*Figure 11. Radio Transmitter BC–1149—(*) (Target), practical wiring diagram.*

# SECTION IX
# SUPPLEMENTARY DATA

(Not applicable)